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DOCUMENT-IDENTIFIER: US 20010036641 A1

TITLE: Methods and devices for carrying out chemical reactions

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20010036641Summary of Invention Paragraph (13):

[0012] The goal of array fabrication is to produce a matrix of the order of 10,000 probe sites or more in an area several to tens of millimeters on a side. Each oligonucleotide probe has a length typically in the 10 to 40 base pair length. Many methods have been put forth for fabricating such arrays. In one approach the oligonucleotide probes are spotted on a suitable surface to produce an array. For this purpose, pre-synthesized probes are employed. In another approach a substrate is prepared upon which is located microdrop-sized loci at which chemical compounds are synthesized or diagnostic tests are conducted. The loci are formed by applying microdrops from which a microdrop is pulse-fed onto the surface of the substrate.

Summary of Invention Paragraph (18):

[0017] Array plates have been discussed where a glass support surface is coated with a positive or negative photoresist substance and then exposed to light and developed to create a patterned region of a first exposed surface and a photoresist coated surface on the support. The first exposed surface is reacted with a fluoroalkylsilane to form a stable fluoroalkylsiloxane hydrophobic matrix on the first exposed surface. The photoresist coat on the surface is removed so as to form a second exposed surface, which is reacted with a hydroxy- or aminoalkylsilane so as to convert the second exposed surface to a derivatized hydrophilic binding site region and thus form the array plate.

Summary of Invention Paragraph (19):

[0018] In another approach a biological electrode array is used. Each electrode in the array is coupled to a respective sample-and-hold circuit. The electrodes and sample-and-hold circuits are integral and form an array within a single semiconductor chip, such that each sample-and-hold circuit may be loaded with a predefined voltage provided by a single, time-shared digital-to-analog converter. All of the sample-and-hold may be accessed through a multiplexer that may scan through some or all of the electrode locations. Each sample-and-hold circuit may comprise a capacitor and one or more transistor switches, which, when closed, provide electrical communication between the capacitor and a source line formed in the matrix.

Summary of Invention Paragraph (26):

[0025] Heller, et al., (Heller 3) disclose apparatus and methods for active programmable matrix devices in PCT application, WO 97/12030.

Summary of Invention Paragraph (34):

[0033] An electrode configuration for matrix addressing of a molecular detection device is discussed by Ackley in U.S. Pat. No. 5,728,532.

Summary of Invention Paragraph (35):

[0034] PCT WO 95/25116 (Baldeschwieler, et al.) discloses a method and apparatus for performing multiple sequential reactions on a matrix.

Summary of Invention Paragraph (42):

[0040] Another aspect of the present invention is a chip for electronically addressing a matrix of sites, to each of which may be directed a chemical reaction. The chip comprises (a) a semiconductor substrate, (b) a matrix of electronic circuit cells fabricated within the semiconductor substrate, (c) address decoders for activating a cell in response to an address applied to the chip, (d) a data bus for delivering binary numerical data to the cells, (e) storage means in each of the cells for storing binary numerical data from the data bus when activated by addresses decoded by the address decoders, (f) digital to-analog conversion means in each cell for converting binary numerical data into an electrical signal, (g) an electrode plate connected to each of the digital-to-analog conversion means. Electrical signals representative of the binary numerical data are selectively applied to each of the electrode plates for the purpose of inducing, when the device is placed proximal to a chemical medium, selective chemical activity according to the binary numerical data provided.

Summary of Invention Paragraph (44):

[0042] Another aspect of the present invention is a method of fabricating a plurality of individual chips, each for electronically addressing a matrix of sites, each site to which may be directed a chemical reaction. A plurality of such individual chips is prepared on a single silicon substrate, which is severed into said individual chips.

Detail Description Paragraph (70):

[0114] The number of oligonucleotides synthesized on the device as well as the size of each site of oligonucleotide synthesis are governed by number of factors, such as the nature and amount of the analyte, the desired level of sensitivity, cost, chip yield, and the like. Generally, an upper limit is the comparable RAM chip density. The number of sites may be from about 2 to about 16 million, usually about 100 to about 100,000 and the size of each site maybe from about 5 microns to about 1 mm, usually, about 20 to about 200 microns. Generally, larger sites mean greater sensitivity but possibly greater requirements for sample volume. If relatively few sites are needed, arid sample is plentiful, then the individual sites can be made up to 1 mm square. Circuit density ceases to be an issue. Various approaches may be used for processing the wafer such as known processing techniques as applied to a 6-inch wafer such as those described in Sze, supra. If an acceptable cell size may be relatively large, for example, 50 micron square, then an inexpensive older IC process may be used. Alternatively, other low cost per unit area processes may be used such as those common to manufacturing large active matrix LCD displays.

CLAIMS:

30. A chip for electronically addressing a matrix of sites, each site to which may be directed a chemical reaction; said chip comprising: (a) a semiconductor substrate; (b) a matrix of electronic circuit cells fabricated within said semiconductor substrate, (c) address decoders for activating a cell in response to an address applied to said chip; (d) a data bus for delivering binary numerical data to said cells; (e) storage means in each of said cells for storing binary numerical data from the data bus when activated by addresses decoded by said address decoders, (f) digital to-analog conversion means in each cell for converting binary numerical data into an electrical signal; (g) an electrode plate connected to each of said digital-to-analog conversion means, wherein electrical signals representative of said binary numerical data are selectively applied to each of said electrode plates for the purpose of inducing, when the device is placed proximal to a chemical medium, selective chemical activity according to the binary numerical data provided.

33. A method of fabricating a plurality of individual chips, each for electronically addressing a matrix of sites, each site to which may be directed a chemical reaction, said method comprising: (a) preparing a plurality of said chips on a single silicon substrate, and (b) severing said single silicon substrate into said individual chips.